

torque, and air loads, occurring during retraction at any airspeed up to $1.6 V_{S1}$ with flaps retracted, and for any load factor up to those specified in § 23.345 for the flaps-extended condition.

(2) The landing gear and retracting mechanism, including the wheel well doors, must withstand flight loads, including loads resulting from all yawing conditions specified in § 23.351, with the landing gear extended at any speed up to at least $1.6 V_{S1}$ with the flaps retracted.

(b) *Landing gear lock.* There must be positive means (other than the use of hydraulic pressure) to keep the landing gear extended.

(c) *Emergency operation.* For a landplane having retractable landing gear that cannot be extended manually, there must be means to extend the landing gear in the event of either—

(1) Any reasonably probable failure in the normal landing gear operation system; or

(2) Any reasonably probable failure in a power source that would prevent the operation of the normal landing gear operation system.

(d) *Operation test.* The proper functioning of the retracting mechanism must be shown by operation tests.

(e) *Position indicator.* If a retractable landing gear is used, there must be a landing gear position indicator (as well as necessary switches to actuate the indicator) or other means to inform the pilot that each gear is secured in the extended (or retracted) position. If switches are used, they must be located and coupled to the landing gear mechanical system in a manner that prevents an erroneous indication of either “down and locked” if each gear is not in the fully extended position, or “up and locked” if each landing gear is not in the fully retracted position.

(f) *Landing gear warning.* For landplanes, the following aural or equally effective landing gear warning devices must be provided:

(1) A device that functions continuously when one or more throttles are closed beyond the power settings normally used for landing approach if the landing gear is not fully extended and locked. A throttle stop may not be used in place of an aural device. If there is a manual shutoff for the warn-

ing device prescribed in this paragraph, the warning system must be designed so that when the warning has been suspended after one or more throttles are closed, subsequent retardation of any throttle to, or beyond, the position for normal landing approach will activate the warning device.

(2) A device that functions continuously when the wing flaps are extended beyond the maximum approach flap position, using a normal landing procedure, if the landing gear is not fully extended and locked. There may not be a manual shutoff for this warning device. The flap position sensing unit may be installed at any suitable location. The system for this device may use any part of the system (including the aural warning device) for the device required in paragraph (f)(1) of this section.

(g) *Equipment located in the landing gear bay.* If the landing gear bay is used as the location for equipment other than the landing gear, that equipment must be designed and installed to minimize damage from items such as a tire burst, or rocks, water, and slush that may enter the landing gear bay.

[Doc. No. 4080, 29 FR 17955, Dec. 18, 1964, as amended by Amdt. 23-7, 34 FR 13091, Aug. 13, 1969; Amdt. 23-21, 43 FR 2318, Jan. 1978; Amdt. 23-26, 45 FR 60171, Sept. 11, 1980; Amdt. 23-45, 58 FR 42164, Aug. 6, 1993; Amdt. 23-49, 61 FR 5166, Feb. 9, 1996]

§ 23.731 Wheels.

(a) The maximum static load rating of each wheel may not be less than the corresponding static ground reaction with—

- (1) Design maximum weight; and
- (2) Critical center of gravity.

(b) The maximum limit load rating of each wheel must equal or exceed the maximum radial limit load determined under the applicable ground load requirements of this part.

[Doc. No. 4080, 29 FR 17955, Dec. 18, 1964, as amended by Amdt. 23-45, 58 FR 42165, Aug. 6, 1993]

§ 23.733 Tires.

(a) Each landing gear wheel must have a tire whose approved tire ratings (static and dynamic) are not exceeded—

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(1) By a load on each main wheel tire) to be compared to the static rating approved for such tires) equal to the corresponding static ground reaction under the design maximum weight and critical center of gravity; and

(2) By a load on nose wheel tires (to be compared with the dynamic rating approved for such tires) equal to the reaction obtained at the nose wheel, assuming the mass of the airplane to be concentrated at the most critical center of gravity and exerting a force of 1.0 W downward and 0.31 W forward (where W is the design maximum weight), with the reactions distributed to the nose and main wheels by the principles of statics and with the drag reaction at the ground applied only at wheels with brakes.

(b) If specially constructed tires are used, the wheels must be plainly and conspicuously marked to that effect. The markings must include the make, size, number of plies, and identification marking of the proper tire.

(c) Each tire installed on a retractable landing gear system must, at the maximum size of the tire type expected in service, have a clearance to surrounding structure and systems that is adequate to prevent contact between the tire and any part of the structure of systems.

[Doc. No. 4080, 29 FR 17955, Dec. 18, 1964, as amended by Amdt. 23-7, 34 FR 13092, Aug. 13, 1969; Amdt. 23-17, 41 FR 55464, Dec. 20, 1976; Amdt. 23-45, 58 FR 42165, Aug. 6, 1993]

§ 23.735 Brakes.

(a) Brakes must be provided. The landing brake kinetic energy capacity rating of each main wheel brake assembly must not be less than the kinetic energy absorption requirements determined under either of the following methods:

(1) The brake kinetic energy absorption requirements must be based on a conservative rational analysis of the sequence of events expected during landing at the design landing weight.

(2) Instead of a rational analysis, the kinetic energy absorption requirements for each main wheel brake assembly may be derived from the following formula:

$KE=0.0443 WV^2/N$

where—

KE=Kinetic energy per wheel (ft.-lb.);

W=Design landing weight (lb.);

V=Airplane speed in knots. V must be not less than V_{S1} , the poweroff stalling speed of the airplane at sea level, at the design landing weight, and in the landing configuration; and

N=Number of main wheels with brakes.

(b) Brakes must be able to prevent the wheels from rolling on a paved runway with takeoff power on the critical engine, but need not prevent movement of the airplane with wheels locked.

(c) During the landing distance determination required by §23.75, the pressure on the wheel braking system must not exceed the pressure specified by the brake manufacturer.

(d) If antiskid devices are installed, the devices and associated systems must be designed so that no single probable malfunction or failure will result in a hazardous loss of braking ability or directional control of the airplane.

(e) In addition, for commuter category airplanes, the rejected takeoff brake kinetic energy capacity rating of each main wheel brake assembly must not be less than the kinetic energy absorption requirements determined under either of the following methods—

(1) The brake kinetic energy absorption requirements must be based on a conservative rational analysis of the sequence of events expected during a rejected takeoff at the design takeoff weight.

(2) Instead of a rational analysis, the kinetic energy absorption requirements for each main wheel brake assembly may be derived from the following formula—

$KE=0.0443 WV^2N$

where,

KE=Kinetic energy per wheel (ft.-lbs.);

W=Design takeoff weight (lbs.);

V=Ground speed, in knots, associated with the maximum value of V_1 selected in accordance with §23.51(c)(1);

N=Number of main wheels with brakes.

[Amdt. 23-7, 34 FR 13092, Aug. 13, 1969, as amended by Amdt. 23-24, 44 FR 68742, Nov. 29, 1979; Amdt. 23-42, 56 FR 354, Jan. 3, 1991; Amdt. 23-49, 61 FR 5166, Feb. 9, 1996]